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FLAT-HEADED BORERS AFFECTING FOREST TREES IN THE UNITED STATES.

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IMPORTANCE OF FLAT-HEADED BORERS.

Flat-headed borers (buprestid larvæ) are among the most important of the borers infesting forest trees in the United States. Some mine the leaves, one burrows into the cones, a number bore into the inner bark and outer wood of the trunk, branches, and roots, while the majority excavate oval winding "wormholes" throughout the sound or decaying sapwood and heartwood.

At present the leaf-miners and the cone-burrower are not common enough to be important. The bark-borers often girdle and kill healthy trees or those injured by fire, floods, droughts, diseases, other insects, or careless lumbering, and at other times weaken trees so that they become easy victims of diseases, other insects, or unfavorable environment. Sometimes when they do not kill the tree outright their work causes dead limbs or twigs, or serious defects, checks, or gum spots to form in the wood, or swollen galls to form on the branches. The wood-borers mine the sapwood and heartwood of the trunk, top, and larger branches and thus destroy or seriously injure a large amount of the tree's most valuable product, its timber. Wormholes will cause the finest grade clear lumber to become unfit for the higher grade uses and therefore unsalable at the higher prices.

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FOOD PLANTS.

Both deciduous and coniferous trees, as well as shrubs and herbaceous plants, are attacked. Some genera attack only deciduous trees, some only conifers, while others attack both. Plants of any age may be attacked and any part of the plant from the roots to the leaves, but the principal part is the bark and wood of the main trunk.

CHARACTER OF THE WORK.

The borer work or injury consists of a flattened, oval, gradually enlarging, more or less tortuous mine or wormhole (Pl. VIII, figs. 1, 2), which, when completed, widens out into an elongate oval pupal cell. This cell connects with the outer surface by a short, oval exit hole. The mine has its surface marked by fine, transverse, crescentic lines and is usually tightly packed with arc-like layers of sawdust-like borings and pellets of woody excrement. The injury may be entirely in the bark, entirely in the wood, or, as is usually the case, in both bark and wood.

LIFE HISTORY.

All bark and wood boring flat-headed borers hatch from eggs deposited by the mother beetle singly or in a mass (Pl. IX), on the bark or tucked in some crevice in the bark or wood or under the bark at the edge of a wound. Each larva mines the inner bark or wood until it reaches maturity, when, after mining outward nearly to the surface, it retreats into its mine and forms an oval cell, in which it pupates and transforms to an adult beetle. The beetle rests awhile, then bites its way out, feeds on the bark, foliage, or pollen of some plant, usually its host, and then mates. The female, after depositing eggs to start a new generation, soon dies.

SEASONAL HISTORY.[1]

The egg is usually laid in the spring or summer and the borer hatching from it feeds and rests until the following fall, or the second fall, or even the third fall, before it reaches maturity. It then either rests over the winter in the larval stage and pupates and transforms to the adult the following spring, or it pupates and transforms to the adult in the summer or fall and rests over the winter in the adult stage in the pupal cell. Most of the bark-borers pass the winter in the larval stage and emerge soon after pupating and transforming to adults in the spring. Many of the wood-borers pupate and transform to adults in the summer or fall and pass the winter

[1] Some evidence has been obtained which indicates that certain species may pass the winter in the egg stage. Mr. A. B. Champlain collected a mass of eggs at Colorado Springs on February 12, 1914, which produced young *Chalcophora* larvæ. Certain *Agrilus* larvæ feed in the spring a short time before pupatings and transforming. Individuals of some species pass the winter in the pupal stage. No observation have been made which would indicate that the adults live over the winter after they have emerged.

in the adult stage before emerging. Feeding begins soon after emergence, and mating, egg-laying, and death soon follow, the whole being completed before the end of summer.

SPECIAL HABITS.

So far as known to the writer only two of our genera (*Agrilus* and *Eupristocerus*) cause the formation of galls (Pl. VIII, figs. 3, 6) on the host plant, and in these cases it seems to be more the special nature of the plant to produce the galls than it is the special work of the insect that causes them to be produced. Thus, the same species of insect will produce galls on some plants and not on others, or on one part of a plant and not on other parts of the same plant. A common western form, *Agrilus*, that infests the alder often produces galls in eastern Oregon, while it seldom does so in eastern California. The common *Agrilus bilineatus* Web. of the Eastern States hardly ever produces galls, but it will do so sometimes when it works on the smaller branches of the oak.

Besides the enlarged roughened galls, some species cause "splotch" mines to form in the bark of young shoots or branches.

Chrysophana placida Lec. usually works in the heartwood of dead branches, tops, fire scars, etc., but recently Mr. P. D. Sergent found it mining the cones of the knobcone pine (*Pinus attenuata*) in southern Oregon (Pl. VIII, fig. 5).

In pupating, it seems to be the most natural habit for the bark-borers to pupate in the bark, and most of them will do so if the bark is thick, but where it is thin they will go into the outer wood. The natural habit of the wood-borers is to pupate in the wood, but some will pupate in the bark.

Although the usual food of the adults is the foliage of the host plant (Pl. VIII, fig. 4), some are pollen feeders, and, as has been determined recently by Mr. F. C. Craighead, some will feed on the spores of fungi. In this instance the adult *Agrilus bilineatus* is of some benefit in destroying the spores of the destructive chestnut blight fungus. Mr. L. E. Ricksecker mentions (Entomologica Americana, 1885) having seen adult *Melanophila consputa* Lec. devouring scorched white ants (termites) on an old spruce log.

SPECIAL STRUCTURAL CHARACTERS.

The larvæ of the genus *Agrilus* (Pl. VI, fig. 2) and of the genus *Eupristocerus* (Pl. VI, fig. 1) bear on the thirteenth or last segment a pair of strong, heavily chitinized, toothed forks or forceps. These are absolutely distinct from any structure possessed by any other member of the family. *Polycesta* larvæ have a pair of sunken brownish spots on the head, one on each side of the jaws, a pair on the postero-dorsal surface of the third segment, and a pair on the antero-ventral surface of the fourth segment. The function of these spots

is unknown, but possibly it may be auricular. *Thrincopyge* larvæ have a pair of brownish spots on the median subdorsal areas of the second and third segments which appear to be secondary spiracles.

AGREEMENT OF ADULT AND LARVAL CLASSIFICATIONS.

The buprestid larval classification agrees very well in the grosser features with that of the adults, except in the case of the genus *Anthaxia*. In adult classification this genus is placed between *Melanophila* and *Chrysobothris*, but its larval characters and life history indicate a much closer relation to *Dicerca* and its allies.

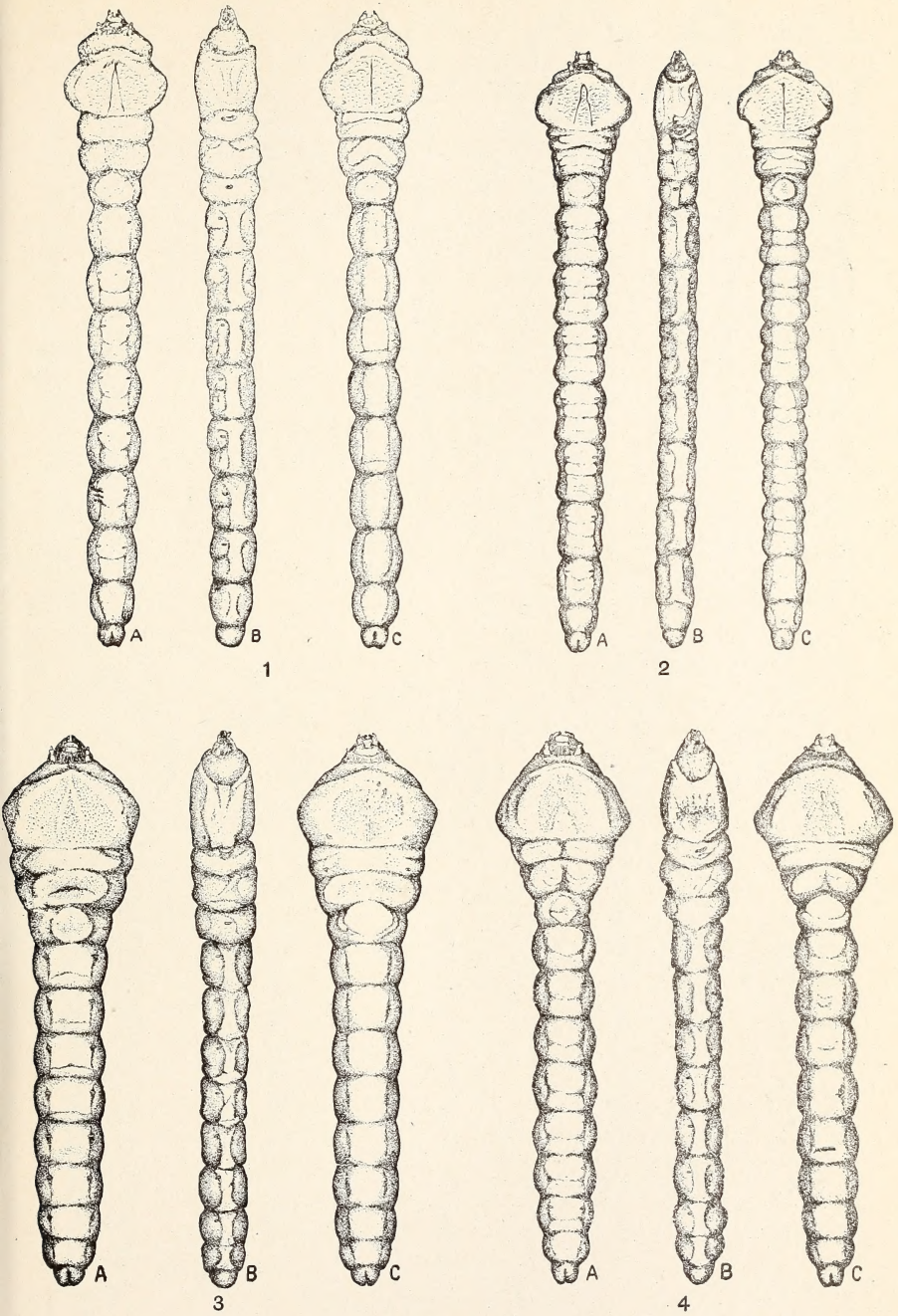
The larval characters strongly indicate that the genus *Buprestis* should be split into three genera and the genus *Melanophila* into two genera.

DISTINGUISHING CHARACTERS.

The principal distinguishing character of the buprestid larva is the occurrence of a well developed ambulatory plate (Pls. I–VI) on both the dorsal and ventral surfaces of the first segment behind the head. Both plates closely resemble one another. Similar plates occur on some of the eucnemid larvæ (Pl. VII, figs. 1, 3), but the markings are different. The buprestids have a central line, groove, or V on the dorsal plate, while the eucnemids have two lateral lines. Cerambycid larvæ (Pl. VII, fig. 2) never have the ventral plate as well developed or similar to the dorsal. Cucujid larvæ (Pl. VII, fig. 4) are very flat, but they can be distinguished from the buprestids at once because of their well developed legs.

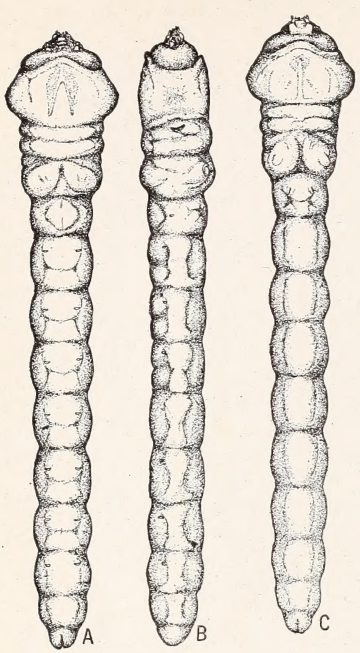
Structurally there are two general types of buprestid larvæ: One (bark and wood borers) "flat-headed," with a long slender subcylindrical tail; the other (leaf-miners) flattened, rather oval, deeply notched, and gradually tapering to the last segment. In the first type, the first segment, taken with the second and third and sometimes the fourth, forms a broader, head-like division from the remainder, which, taken together, forms the long subcylindrical tail. In this type the first segment is much larger and broader than the others, while the thirteenth is usually much smaller. In the second type there is no distinct club head; the first and second segments are only a little narrower or a little broader than the third and fourth and the whole gradually tapers down to the thirteenth.

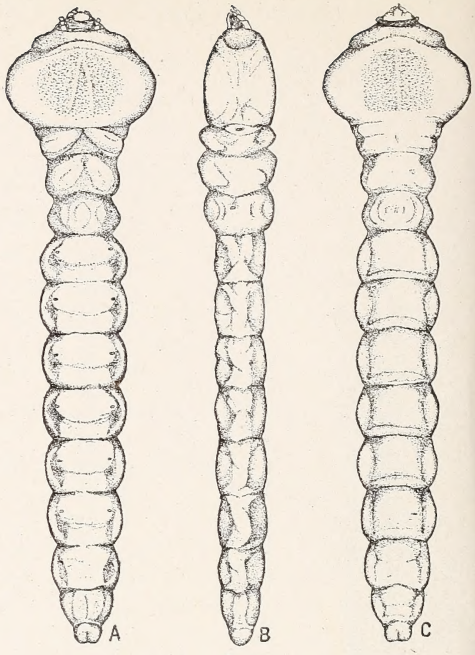
Both types are distinguished by the following characters: Comparatively small head more or less retracted into the first segment of a body composed of 13 fairly well defined, flattened segments; antennæ medium-sized and three-jointed; ocelli wanting; labrum rather large, arched and protruded; mandibles short, strong, usually toothed and rather spoon-shaped; maxillæ well developed; maxillary palpi two-jointed; labium well developed, arched, protruded; labial palpi minute and unsegmented, almost obsolete; first segment with a large, well-developed plate on both the ventral and the dorsal sur-

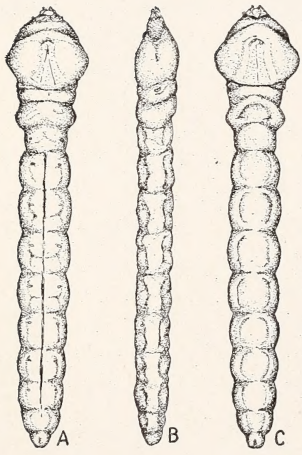


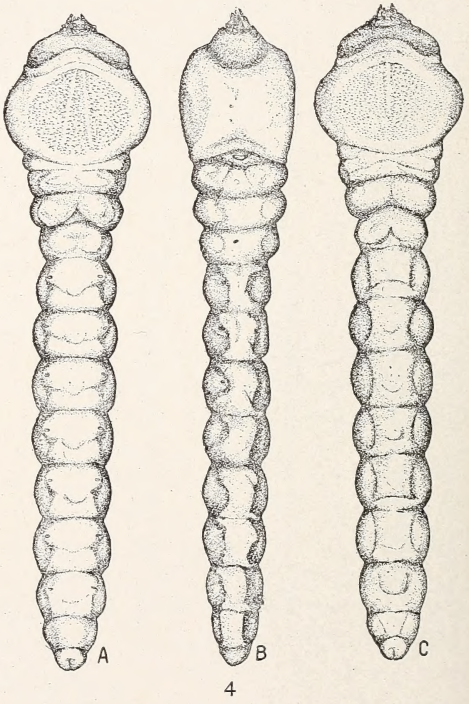
FLAT-HEADED BORERS.

FIG. 1.—*Chalcophora angulicollis:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×1½.
FIG. 2.—*Chalcophorella campestris:* Larva. A, dorsal view; B, dextral view; C, ventral view. ×1½.
FIG. 3.—*Buprestis apricans:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×2.
FIG. 4.—*Buprestis aurulenta:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×2¼. (Drawings by Eleanor T. Armstrong.) (Original.)



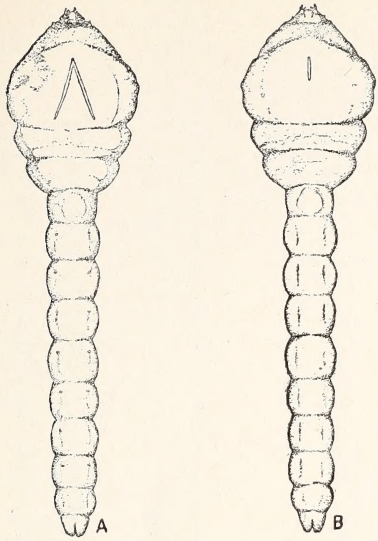


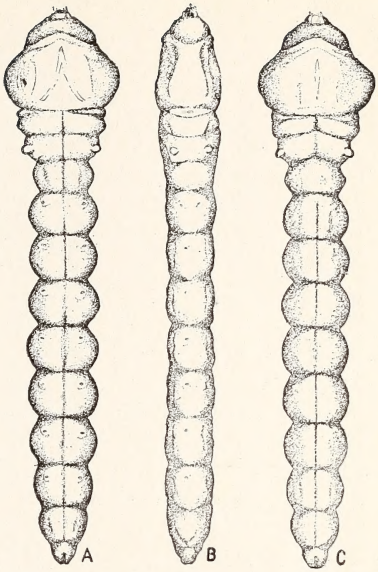


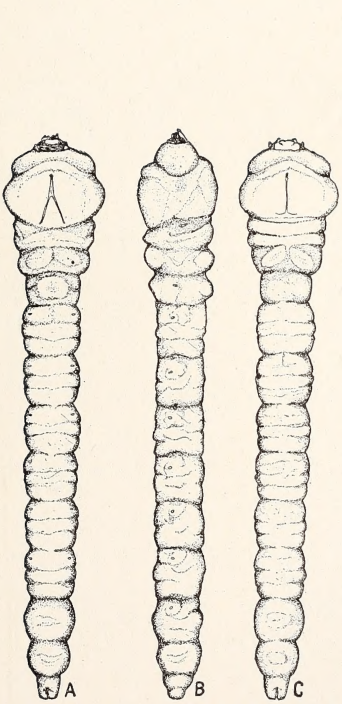


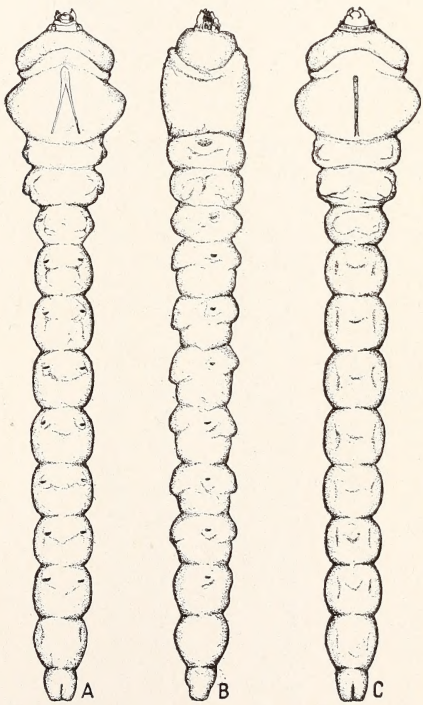
FLAT-HEADED BORERS.

FIG. 1.—*Buprestis laeviventris:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×2.
FIG. 2.—*Melanophila drummondi:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½.
FIG 3.—*Melanophila intrusa:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½.
FIG. 4.—*Chrysobothris trinervia:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½. (Drawings by Eleanor T. Armstrong.) (Original.)



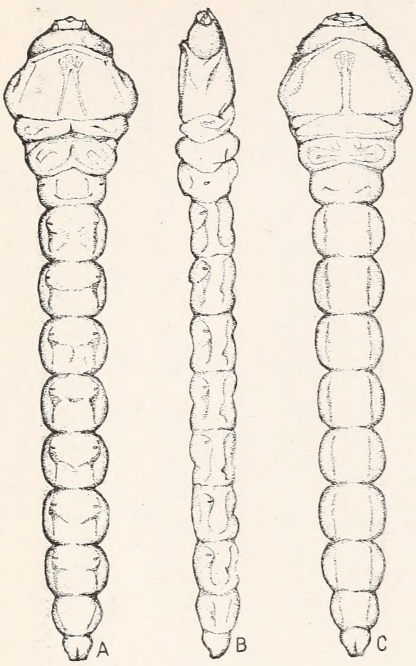






FLAT-HEADED BORERS.

FIG. 1.—*Chrysobothris?:* Larva. A, Dorsal view; B, ventral view. ×3½. FIG. 2.—*Anthaxia aeneogaster:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×5. FIG. 3.—*Cinyra gracilipes:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½. FIG. 4.—*Poecilonota thureura:* Larva. A, Dorsal view; B, sinistral view; C, ventral view. ×3. (Drawings by Eleanor T. Armstrong.) (Original.)



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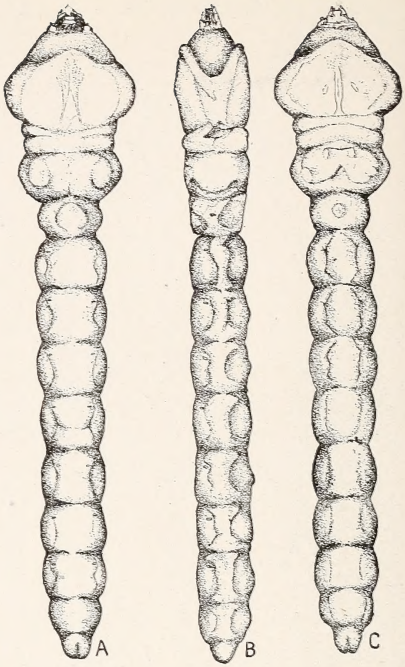

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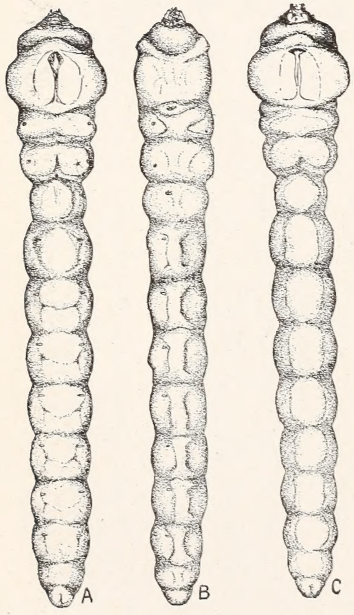

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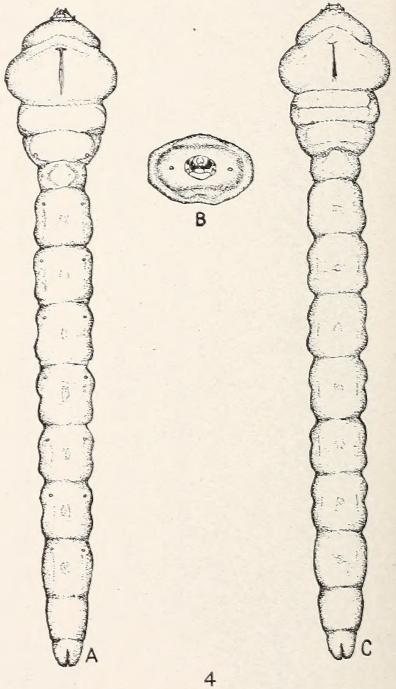

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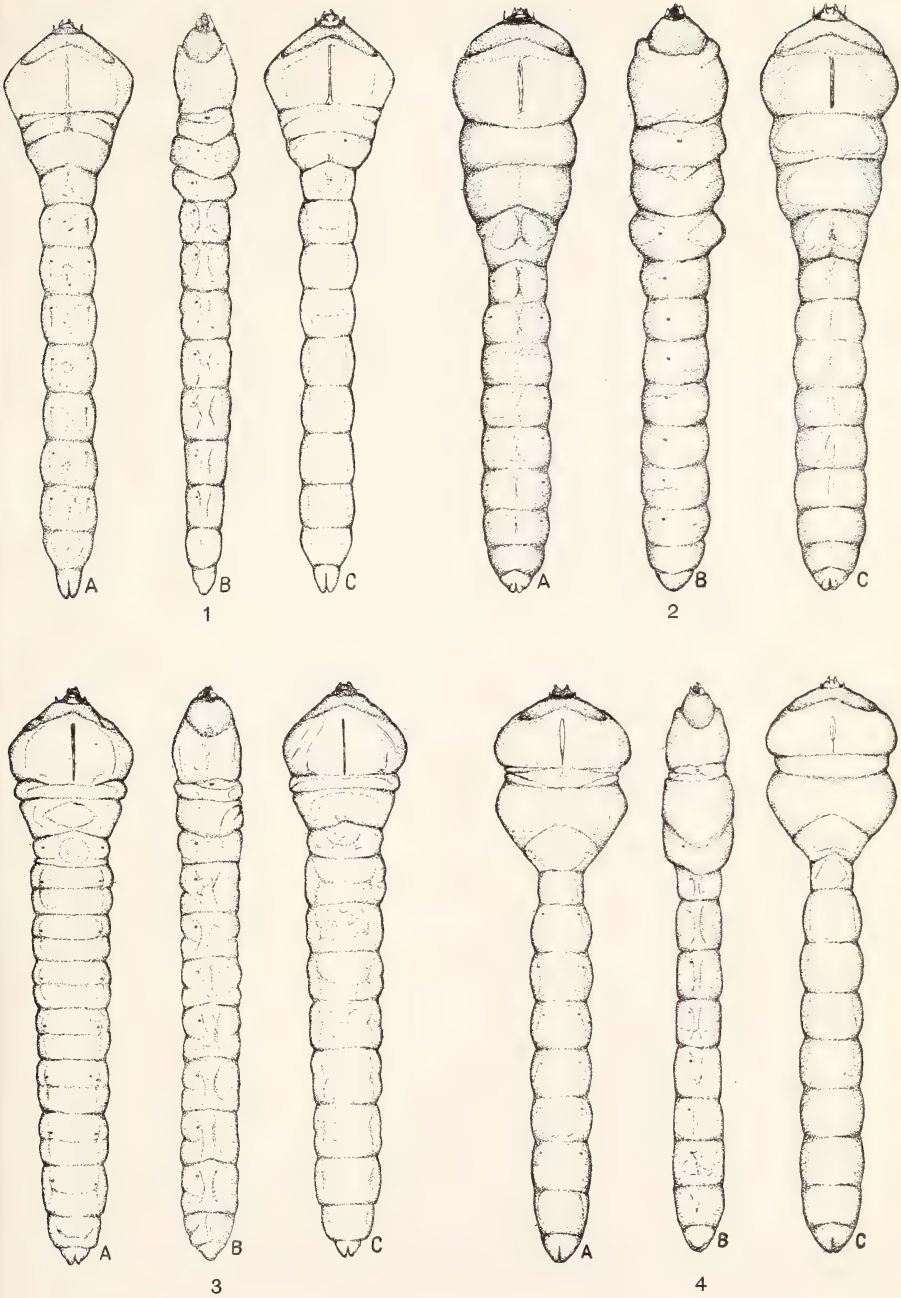
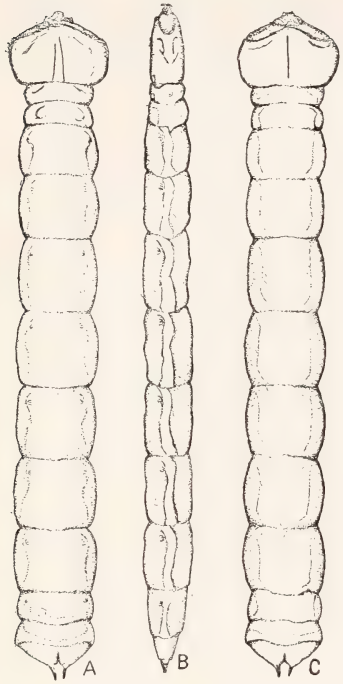
FLAT-HEADED BORERS.

FIG. 1.—*Dicerca prolongata:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×2½.
FIG. 2.—*Trachykele lecontei:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3.
FIG. 3.—*Thrincopyge ambiens:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×2.
FIG. 4.—*Polycesta velasco:* Larva. A, Dorsal view; B, cephalic view; C, ventral view. ×1½.
(Drawings by Eleanor T. Armstrong.) (Original.)



FLAT-HEADED BORERS.

FIG. 1.—*Chrysophana placida:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×4½.
FIG. 2.—*Acmaeodera prorsa:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×4.
FIG. 3.—*Ptosima gibbicollis:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×5.
FIG. 4.—*Tyndaris olneyae:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½.
(Drawings by Eleanor T. Armstrong.) (Original.)



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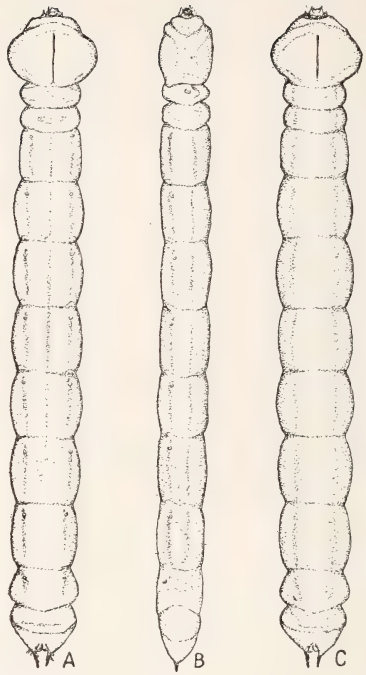

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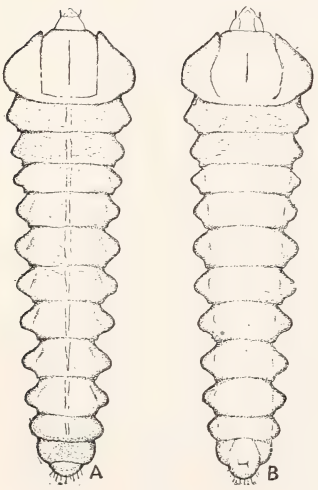

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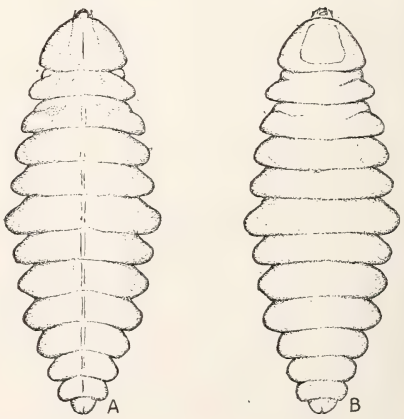
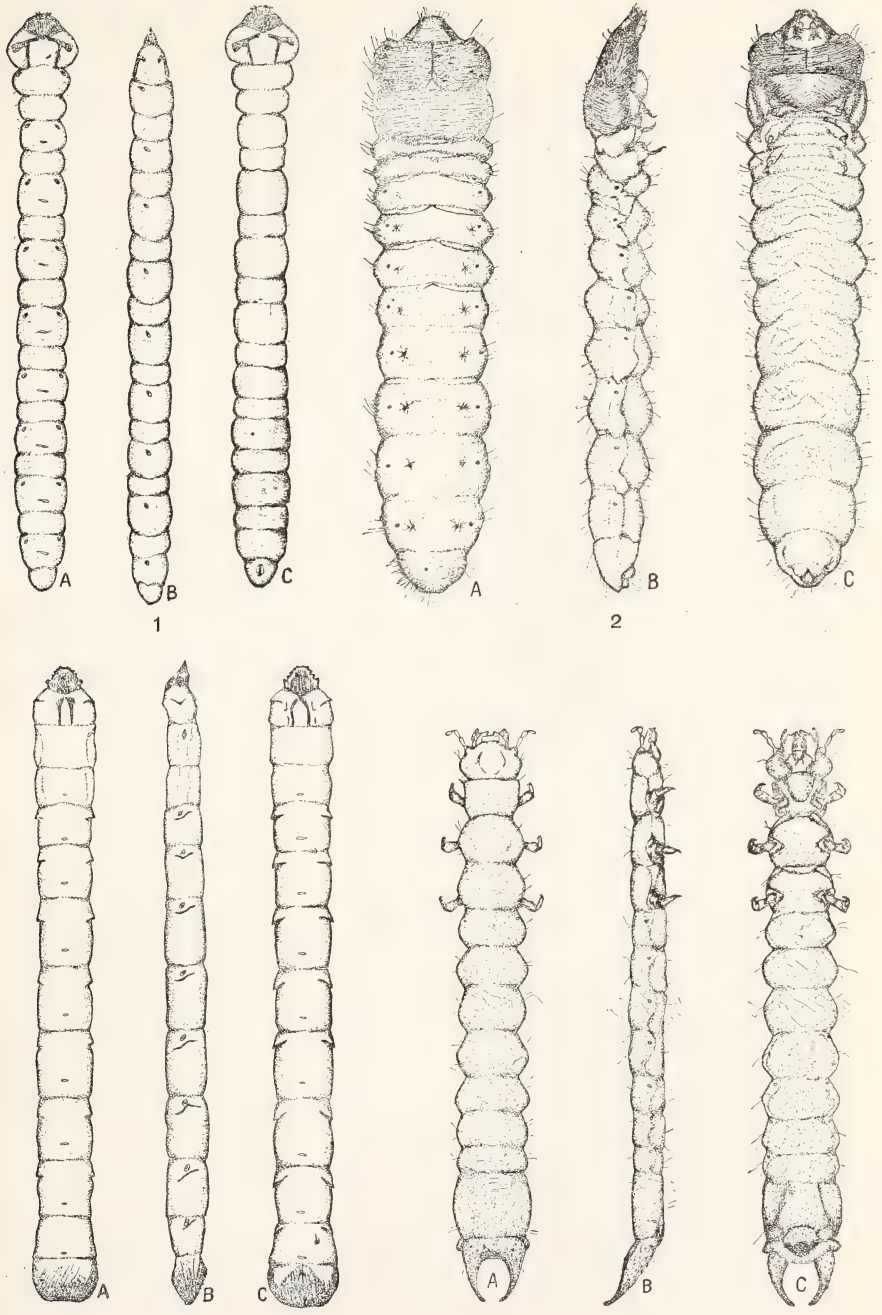


4

FLAT-HEADED BORERS.

FIG. 1.—*Eupristocerus cogitans:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3½.
FIG. 2.—*Agrilus bilineatus:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×4½.
FIG. 3.—*Brachys aerosa:* Larva. A, Dorsal view; B, ventral view. ×5. FIG. 4.—*Pachyscelus schwarzii:* Larva. A, Dorsal view; B, ventral view. ×10. (Drawings by Eleanor T. Armstrong.) (Original.)



EUCNEMID, CERAMBYCID, AND CUCUJID LARVÆ.

FIG. 1.—*Melasis rufipennis:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3. This is a cross borer (eucnemid) often mistaken for a flat-headed borer (buprestid). FIG. 2.—*Rhagium lineatum:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3. This is a round-headed borer (cerambycid) often mistaken for a flat-headed borer (buprestid). FIG. 3.—*Dromaeolus nitens:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3. This is a cross borer (eucnemid) often mistaken for a flat-headed borer (buprestid). FIG. 4.—*Cucujus puniceus:* Larva. A, Dorsal view; B, dextral view; C, ventral view. ×3. A very flat larva found under bark but not a flat-headed borer. (Drawings by Eleanor T. Armstrong.) (Original.)

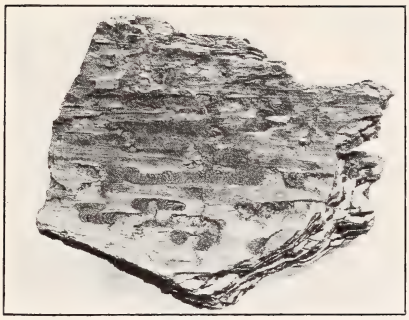


FIG. 1. Bark from dying yellow pine (*Pinus ponderosa*) mined by larvæ of *Melanophila drummondi*. ×½. (Photograph by H. E. Burke.) (Original.)

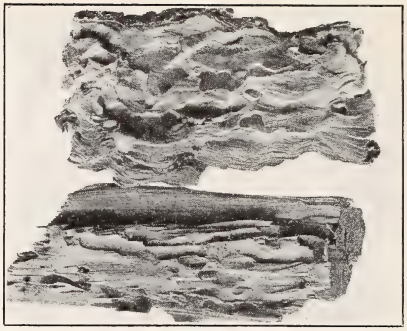


FIG. 2.—Wood from scar on living red fir (*Abies magnifica*) mined by larvæ of *Trachykele nimbosa*. (Photograph by H. E. Burke.) (Original.)

FIG. 3.—Stems from living bush of manzanita (*Arctostaphylos viscida*) showing galls made by mines of larvæ of *Agrilus* sp. ×½. (Photograph by H. E. Burke.) (Original.)

FIG. 4.—Leaves of the live oak (*Quercus wislizeni*) partly eaten by adults of *Agrilus angelicus*. ×½. (Photograph by H. E. Burke.) (Original.)

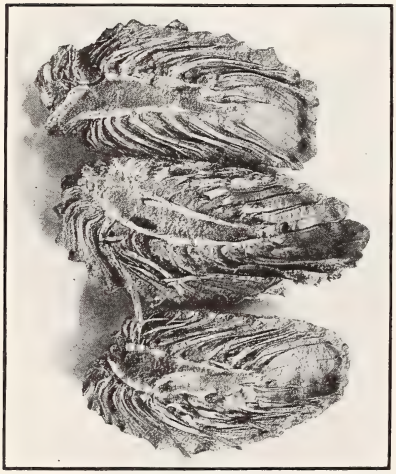
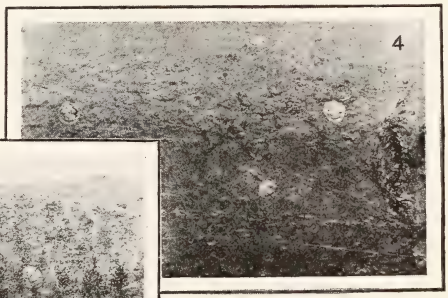
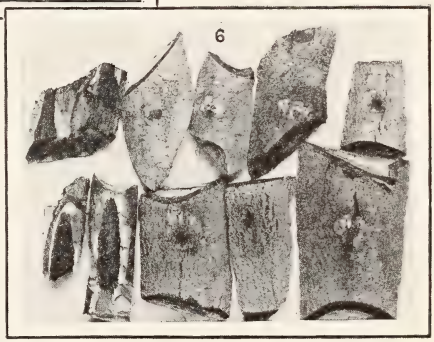


FIG. 5.—Cones of the knobcone pine (*Pinus attenuata*) mined by the larvæ of *Chrysophana placida*. ×½. (Photograph by H. E. Burke.) (Original.)

FIG. 6.—Manzanita (*Arctostaphylos viscida*) bush partly killed by mines of larvæ of *Agrilus* sp. ×$\frac{1}{10}$. (Photograph by H. E. Burke.) (Original.)

WORK OF FLAT-HEADED BORERS.





WORK OF FLAT-HEADED BORERS.

FIG. 1.—Eggs of *Agrilus angelicus* laid singly on twigs of live oak (*Quercus agrifolia*). ×1. FIG. 2.—Egg of *Agrilus* sp. laid singly on stem of manzanita (*Arctostaphylos viscida*). ×4. FIG. 3.—Egg masses of *Agrilus politus* on bark of stem of arroyo willow (*Salix lasiolepis*). Some covered with the protective covering, some uncovered. ×4. FIG. 4.—Egg masses of *Agrilus* sp. on bark of trunk of white alder (*Alnus rhombifolia*). ×4. FIG. 5.—Trunk of living white alder (*Alnus rhombifolia*) showing egg masses of *Agrilus* sp. and the sap flowing from the wounds caused by the feeding of the young larvæ. ×$\frac{3}{4}$. FIG. 6.—Sections from the trunk of a living white alder (*Alnus rhombifolia*) showing old egg masses on the bark, larval work under the bark, and the "craters" formed in the bark when the attack was not severe enough to kill the tree. The brood died in the larval stage and the wound will cause a check in the wood. ×1. (Photographs by H. E. Burke.) (Original.)

faces; true legs wanting; ambulatory tubercles sometimes present; cerci wanting; spiracles crescentic, one large one on either side of the second segment and one small one on either side of each of the fourth to eleventh segments, on the anterior dorso-lateral surface.

KEY TO GENERA OF BUPRESTID LARVÆ.[1]

1. First segment distinctly larger and broader than the following segment; larva clublike or pestlelike in form, somewhat flattened; bark and wood miners (Pl. I, fig. 1) 2
   First segment only slightly broader or slightly narrower than the following segment; larva slightly wedge-shaped (cuneiform) or spindle-shaped (fusiform), much flattened; segments deeply notched and lobed; leaf-miners (Pl. VI, figs. 3, 4) 19
2. Last segment without a distinct chitinous fork (Pl. I, fig. 1) 3
   Last segment with a distinct chitinous fork (Pl. VI, figs. 1, 2) 18
3. Plates of first segment with distinct chitinous rugosities (Pl. I, fig. 1) 4
   Plates of first segment without distinct chitinous rugosities, surface sometimes dull, sometimes shining (Pl. IV) 8
4. Rugosities of first segment strongly developed, tending to form ridges; plates with rather definite margins, markings dark and distinct (Pl. I, fig. 1) 5
   Rugosities of first segment pointlike; plates with indefinite margins, markings light, appearing more as grooves than as definite lines (Pl. I, figs. 3, 4) 6
5. Dorsal plate marked by a distinct inverted Y (Pl. I, fig. 1) ..... *Chalcophora.*
   Dorsal plate marked by a distinct marking more like an inverted V or U than a Y (Pl. I, fig. 2) ..... *Chalcophorella.*
6. Dorsal plate marked by a short, trunked, inverted Y or U, the apex and trunk of which are often faint, rugose area forming more or less of a hood around the Y; ventral plate marked with a median groove that extends from the posterior margin of the plate two-thirds or three-fourths of the distance to the anterior margin, not bisecting the plate (Pl. I, figs. 3, 4; Pl. II, fig. 1) ..... *Buprestis.*
   Dorsal plate marked by an inverted V formed from light grooves; ventral plate marked with a median groove that extends from the anterior margin backward, sometimes bisecting the plate (Pl. II, fig. 3) 7
7. Dorsal plate rather oblong; ventral plate quite narrow, almost rectangular, completely bisected by a median groove; first segment not much larger than the second and third, fourth segment as large as the fifth (Pl. II, figs. 2, 3) ..... *Melanophila.*
   Dorsal plate circular; ventral plate circular, never completely bisected by the median groove, which extends backward from the anterior margin about two-thirds of the distance to the posterior margin; first segment much larger than the other segments, fourth smaller than fifth (Pl. II, fig. 4; Pl. III, fig. 1) ..... *Chrysobothris.*
8. Dorsal plate marked by an inverted V or Y formed of lines or grooves (Pl. III, fig. 2) 9
   Dorsal plate marked by a single median line or groove which may broaden out at either end (Pl. IV, fig. 3) 13
9. Dorsal marking an inverted V of deep grooves, ventral line not bisecting plate, third segment with a pair of ambulatory tubercles above and below, surface shining (Pl. III, fig. 2) ..... *Anthaxia.*
   Dorsal marking an inverted V or Y of dark lines, ventral line bisecting plate, surface rather dull (Pl. IV, fig. 2) 10
10. Both dorsal and ventral markings with narrow simple anterior ends (Pl. III, figs. 3, 4) 11
    Both dorsal and ventral markings with broad reticulated anterior ends (Pl. IV, figs. 1, 2) 12
11. Dorsal marking a long trunked inverted Y with a brownish base, ventral marking a straight bisecting line with a brownish anterior end (Pl. III, fig. 3) ..... *Cinyra.*
    Dorsal marking an inverted V with a simple apex, ventral marking a simple bisecting groove (Pl. III, fig. 4) ..... *Poecilonota.*

[1] So far as determined the characters used in the key hold for larvæ of any stage.

12. Dorsal marking an inverted Y with a depressed shining reticulated diamond-shaped area surrounding the apex (Pl. IV, fig. 2)..... *Trachykele.*
Dorsal marking an inverted V with a broad reticulated apex (Pl. IV, fig. 1) ..... *Dicerca.*
13. Dorsal plate rather small, oval or egg-shaped, marked by a distinct brownish median groove which is goblet-shaped in front and forked behind; a pair of brown spots on the median subdorsal areas of the second and third segments (Pl. IV, fig. 3)..... *Thrincopyge.*
Dorsal plate large, covering most of the dorsal surface, marked by a distinct simple median groove sometimes broadening in front (Pl. IV, fig. 4). 14
14. Ventral plate with a median dark line, both plates slightly corrugated longitudinally, a dark brown sunken spot on either side of the head near the base of the mandible, a pair of brown spots on posterior subdorsal areas of third segment and a pair on anterior ventral area of fourth segment (Pl. IV, fig. 4)..... *Polycesta.*
Ventral plate with simple median line or groove, no sunken spots (Pl. V, fig. 1)..... 15
15. Fourth segment narrower than fifth (Pl. V, figs. 1, 3)..... 16
Fourth segment broader than fifth (Pl. V, figs. 2, 4)..... 17
16. Grooves of first segment light, plates not whitish opaque (Pl. V, fig. 1) ..... *Chrysophana.*
Grooves of first segment dark brown, plates whitish opaque (Pl. V, fig. 3) ..... *Ptosima.*
17. Third segment narrower than second (Pl. V, fig. 2) ..... *Acmaeodera.*
Third segment wider than second, appearing nearly as large as first (Pl. V, fig. 4)..... *Tyndaris.*
18. Dorsal plate marked by two moderately separated dark brown lines which converge anteriorly (Pl. VI, fig. 1)..... *Eupristocerus.*
Dorsal plate marked by a single median bisecting line (Pl. VI, fig. 2).... *Agrilus.*
19. First segment as broad or slightly broader than the following, body gradually tapering to the twelfth, slightly wedge-shaped (Pl. VI, fig. 3)..... *Brachys.*
First segment narrower than the following, body tapering both ways from about the middle, more acute at the posterior end, spindle-shaped (Pl. VI, fig. 4)..... *Pachyscelus.*

NOTE.—The author will be glad to determine specimens of "flat-headed borers," and for anyone, if the locality and host plant are given. Such specimens should be sent to Forest Insect Investigations, Bureau of Entomology, Washington, D. C. So far as known no larvæ of the genera *Gyascutus, Hippomedas, Agaeocera, Psiloptera, Xenorhipis, Actenodes, Gyptoscelimorpha, Dystaxia, Schizopus, Masiogenius, Rhaeboscelis,* and *Taphrocerus* have been collected. *Xenorhipis* has been reared from hickory twigs and *Mastogenius* from oak twigs, both in the Southern States, but the larvæ have not been collected.

List of Genera, Distribution, Common Habits, and Host Trees.

Chalcophora. Throughout United States, wood-borer in the stump and trunk of injured, dying, and dead trees: Pine (*Pinus*), Douglas spruce (*Pseudotsuga*), and fir (*Abies*).

Chalcophorella (*Texania*). Atlantic States, wood-borer in the stump and trunk of injured, dying, and dead trees: Beech (*Fagus*), oak (*Quercus*), and sycamore (*Platanus*).

Buprestis. Throughout United States, wood-borer in the stump and trunk of injured, dying, and dead trees: Pine (*Pinus*), spruce (*Picea*), Douglas spruce (*Pseudotsuga*), fir (*Abies*), hickory (*Hicoria*), aspen and cottonwood (*Populus*), beech (*Fagus*), chestnut (*Castanea*), oak (*Quercus*), and tulip (*Liriodendron*).

Melanophila. Throughout United States, bark-borer in the stump, trunk, top, and branches of healthy, injured, dying, and dead trees: Pine (*Pinus*), larch (*Larix*), spruce (*Picea*), hemlock (*Tsuga*), Douglas spruce (*Pseudotsuga*), and fir (*Abies*). Kills many trees and causes checks or "gum spots" in the wood of others.

Chrysobothris. Throughout United States, bark and sapwood borer in the roots, stump, trunk, top, and branches of injured, dying, and dead shrubs and trees: Pine (*Pinus*), spruce (*Picea*), Douglas spruce (*Pseudotsuga*), fir (*Abies*), bald cypress (*Taxodium*), incense cedar (*Libocedrus*), cypress (*Cupressus*), juniper (*Juniperus*), butternut and walnut (*Juglans*), hickory (*Hicoria*), willow (*Salix*), aspen, poplar, and cottonwood (*Populus*), birch (*Betula*), alder (*Alnus*), beech (*Fagus*), chestnut (*Castanea*), oak (*Quercus*), elm (*Ulmus*), hackberry (*Celtis*), sweet gum (*Liquidambar*), mountain mahogany (*Cercocarpus*), apple (*Pyrus*), Christmas berry (*Heteromeles*), plum, cherry, and peach (*Prunus*), catsclaw (*Acacia*), mesquite (*Prosopis*), redbud

(*Cercis*), palo verde (*Cercidium*), creosote-bush (*Covillea*), maple (*Acer*), zizyphus (*Zizyphus*), coffee-berry (*Rhamnus*), grape (*Vitis*), ocatillo (*Fouquieria*), basswood (*Tilia*), dogwood (*Cornus*), wild lilac (*Ceanothus*), sour gum (*Nyssa*), and persimmon (*Diospyros*). Kills injured shrubs and trees.

Anthaxia. Throughout United States, bark-borer in trunk and branches of injured, dying, and dead shrubs and trees: Pine (*Pinus*), Douglas spruce (*Pseudotsuga*), fir (*Abies*), hickory (*Hicoria*), willow (*Salix*), oak (*Quercus*), elm (*Ulmus*), mountain mahogany (*Cercocarpus*), service berry (*Amelanchier*), plum (*Prunus*), redbud (*Cercis*), grape (*Vitis*), and paulownia (*Paulownia*). Kills injured shrubs.

Xenorhipis. Southern States, twig-miner in dead twigs: Hickory (*Hicoria*).

Cinyra. Atlantic States, wood-miner in dead limbs: Oak (*Quercus*).

Poecilonota. Throughout United States, bark and wood miner in trunk of injured trees: Willow (*Salix*) and aspen and cottonwood (*Populus*).

Trachykele. Southern, Rocky Mountain, and Pacific States, wood-borer in stump, trunk, and branches of injured, dying, and dead trees: Hemlock (*Tsuga*), fir (*Abies*), bald cypress (*Taxodium*), big tree (*Sequoia*), incense cedar (*Libocedrus*), arborvitae (*Thuja*), cypress (*Cupressus*), and juniper (*Juniperus*).

Dicerca. Throughout United States, wood-borer in the stump, trunk, and branches of injured, dying, and dead shrubs and trees: Pine (*Pinus*), spruce (*Picea*), Douglas spruce (*Pseudotsuga*), fir (*Abies*,) bald cypress (*Taxodium*), butternut (*Juglans*), hickory (*Hicoria*), willow (*Salix*), aspen, poplar, and cottonwood (*Populus*), birch (*Betula*), alder (*Alnus*), beech (*Fagus*), oak (*Quercus*), elm (*Ulmus*), hackberry (*Celtis*), mountain mahogany (*Cercocarpus*), cherry, peach, plum (*Prunus*), sumach (*Rhus*), and poison oak (*Toxicodendron*), maple (*Acer*), buckeye (*Aesculus*), coffee-berry (*Rhamnus*), wild lilac (*Ceanothus*), dogwood (*Cornus*), black gum (*Nyssa*), persimmon (*Diospyros*), ash (*Fraxinus*), and snowberry (*Symphoricarpus*).

Thrincopyge. Southwestern States, wood or pith borer in the flower stem: Yucca, Spanish bayonet, palmio, sotal (*Dasylirion*); nolina (*Nolina*).

Polycesta. Southwestern and Pacific States, wood-borer in the stump, trunk, and branches of injured, dying, and dead shrubs and trees: Cottonwood (*Populus*), alder (*Alnus*), oak (*Quercus*), sycamore (*Platanus*), mountain mahogany (*Cercocarpus*), apple and pear (*Pyrus*), Christmas berry (*Heteromeles*), almond (*Prunus*), catsclaw (*Acacia*), mesquite (*Prosopis*), redbud (*Cercis*), palo verde (*Cercidium*), maple (*Acer*), and manzanita (*Arctostaphylos*).

Chrysophana. Rocky Mountain and Pacific States, wood-borer in stump, trunk, top, and branches of injured, dying, and dead trees: Pine (*Pinus*), hemlock (*Tsuga*), Douglas spruce (*Pseudotsuga*), fir (*Abies*), and arborvitae (*Thuja*). Cone-burrower in cones of knobcone pine (*Pinus attenuata*).

Acmaeodera. Throughout United States, wood-borer in stump, trunk, top, and branches of shrubs and trees: Bald cypress (*Taxodium*), yucca sotal (*Dasylirion*), hickory (*Hicoria*), poplar (*Populus*), alder (*Alnus*), oak (*Quercus*), hackberry (*Celtis*), California laurel (*Umbellularia*), mountain mahogany (*Cercocarpus*), apple and pear (*Pyrus*), service berry (*Amelanchier*), Christmas berry (*Heteromeles*), choke cherry (*Padus*), plum and almond (*Prunus*), redbud (*Cercis*), palo verde (*Cercidium*), ironwood (*Olneya*), lupine (*Lupinus*), china ash (*Melia*), poison oak (*Toxicodendron*), zizyphus (*Zizyphus*), coffee-berry (*Rhamnus*), wild lilac (*Ceanothus*), manzanita (*Arctostaphylos*), and yerba santa (*Eriodictyon*).

Tyndaris. Southwestern States, wood-borer in roots, trunk, and branches of injured, dying, and dead shrubs and trees: Catsclaw (*Acacia*), mesquite (*Prosopis*), and ironwood (*Olneya*).

Ptosima. Atlantic States, wood-borer in stump, trunk, top, and branches of injured, dying, and dead shrubs: Redbud (*Cercis*).

Mastogenius. Southern States, twig-borer in fire-killed saplings: Spanish oak (*Quercus*).

Eupristocerus. Atlantic States, bark-borer in branches of living shrubs and trees: Alder (*Alnus*). Causes the formation of enlarged growths (galls).

Agrilus. Throughout United States, bark and wood borer in roots, stump, trunk, top, and branches of healthy, injured, dying, and dead shrubs and trees: Butternut and walnut (*Juglans*), hickory (*Hicoria*), willow (*Salix*), aspen, poplar, cottonwood, and Balm of Gilead (*Populus*), birch (*Betula*), alder (*Alnus*), ironwood and hornbeam (*Ostrya*), beech (*Fagus*), chestnut (*Castanea*), oak (*Quercus*), hackberry (*Celtis*), mulberry (*Morus*), raspberry and blackberry (*Rubus*), apple (*Pyrus*), serviceberry (*Amelanchier*), catsclaw (*Acacia*), coffee-tree (*Gymnocladus*), locust (*Robinia*), sumach (*Rhus*),

maple (*Acer*), dogwood (*Cornus*), madrone (*Arbutus*), manzanita (*Arctostaphylos*), aster (*Aster*), and sagebrush (*Artemisia*). Kills many shrubs and trees, often causing the formation of galls and checks in the wood.

Brachys. Eastern and Central States, leaf-miner in leaves: *Populus*?, alder (*Alnus*), *Fagus*?, chestnut (*Castanea*), oak (*Quercus*), *Ulmus*?, and *Acer*?.

Pachyscelus. Eastern States, leaf-miner in leaves: *Hicoria*?, *Quercus*?, and *Lespedeza*.

NOTE.—Host tree as given indicates, for bark and wood borers, that borer was actually taken from bark and wood and not that the adult was resting on the bark or wood.

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